Iowa Science Teachers Journal

Volume 15 | Number 1 Article 4

1978

Individualized Chemistry for the Gifted Student

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Introduction

Through a Teacher Incentive Award from the Iowa Department of Public Instruction, the honors chemistry course of Ames Senior High School has been converted into a packet form. The packets are flexible enough so the gifted chemistry student may be integrated into the chemistry B sections or the packets may be used for a separate honors chemistry class. The flexible sequencing allows the same topics to be studied concurrently with the chemistry B students.

Ames Senior High School has three levels of chemistry for its seniors. The levels are:

——Chemistry A that has no prerequisites

——Chemistry B that requires one year of physics and at least a second year algebra course

——Honors chemistry that requires one year of upper track physics (PSSC), advanced mathematics, plus approval of the science department

About forty to fifty percent of the seniors elect chemistry each year. The female to male ratio is usually about 1:1.

The Specific Objectives of This Project

The specific objectives of this project are:

1. To provide an individualized program for the gifted chemistry students of Ames Senior High School;

2. To provide a chemistry program where the gifted students can achieve at a high level as measured by an advanced chemistry test published by the American Chemical Society; and

3. To provide a chemistry program so the gifted chemistry students of Ames Senior High School will develop a positive attitude toward chemistry as measured by a pre-test and post-test attitude scale.

Course Description

The course has been organized into twenty-two packets. These packets were developed using the 3rd edition of Masterton's and Slowinski's *Chemical*

Principles, 1973, and the 2nd edition of *Chemical Principles in the Laboratory*, 1973, Slowinski, Masterton, and Wolsey, published by W. B. Saunders Company, as the principal text and laboratory manual.

The packets contain the following:

—Behavioral objectives
—Reading and study guides
—Space for working the assigned problems
—Laboratory data sheets and questions
—Supporting audio-visual and audio-tutorial lessons
—Supplemental readings

An unpublished laboratory manual, written by the chemistry teachers of Ames Senior High School, is also used. About twenty experiments that teach laboratory techniques and emphasize the applications of chemistry help supplement the laboratory part of the program.

Each packet was revised during the 1976-77 school year using student and staff input.

Tests have been written for each packet. Packets 20 and 21 have a combined test.

Description of the Students Who Elect Honors Chemistry

The students who elect honors chemistry are very bright and talented. The average IQ of the class will exceed 130. These students generally are involved in many of the extracurricular activities that our high school provides. Most of the students are concurrently enrolled in trigonometry, analytical geometry, or calculus. All have had a year of PSSC physics.

History of the Development of the Packet Material

During the 1974-75 school year, all 11 students that elected honors chemistry were integrated into the chemistry B sections. The sequencing was such that the same topics were studied by both the honors and chemistry B sections.

For the 1975-76 school year, the 23 students who elected honors chemistry were taught as a separate class.

In our initial proposal for funding of the packet program from the Iowa Department of Public Instruction we had planned to integrate the gifted chemistry students among the four chemistry B sections. With an initial enrollment of 21 students we decided to teach the honors chemistry course as a separate course. Gifted students tend to dominate class activities if a separate course is being offered concurrently.

The honors chemistry class for the 1976-77 school year had 10 female students and 11 male students. One male student dropped back to the

chemistry B level. One female student transferred from a lower level (chemistry B) at the start of the second semester. She worked independently with the honors packets for about six weeks before transferring. Four students worked ahead of the course schedule to do make up for a three-week foreign language trip to Europe.

Data Collection

During the first week of the 1976 school year, the honors chemistry students were given an attitude survey. This survey is the same as used by Jones[1]. The attitude survey consisted of eighteen descriptive terms organized in the semantic differential format. The honors chemistry students were asked to anonymously express their reactions to chemistry, laboratory work, honors classes, and the packets. The same semantic differential format was used in March to determine the students' attitudes toward the four areas described above.[2] Table 1 below gives a sample of the descriptors used.

Table 1

CHEMISTRY

	7	6	5	4	3	2	1	
Important	0	0	0	0	0	0	0	**Unimportant**
Unproductive	0	0	0	0	0	0	0	**Productive**
Useful	0	0	0	0	0	0	0	**Useless**
Successful	0	0	0	0	0	0	0	**Unsuccessful**
Bad	0	0	0	0	0	0	0	**Good**
Comforting	0	0	0	0	0	0	0	**Threatening**

In May of each year of the program a final achievement test, ADV-Chemistry, ACS-NSTA, form 1974 was given.

Discussion of the Result of Attitudinal Survey

The result of the pre- and post-attitudinal test is summarized in Table 2. A mean of 72 on the 126 point semantic-differential is a neutral value.[3]

The results show there was a positive change in attitude in all of the areas surveyed. There was a significant positive increase toward using of the packets.

The mean scores on the attitude measures were higher than Jones obtained for the Ames High School physics and chemistry students in 1972. His survey for the pre- and post-attitudinal test averaged 82 and 81.4, respectively. Using the same measurement, the 1976-77 honors chemistry students averaged 87.3 and 93.8 for the pre- and post-attitudinal test, respectively, on the four areas surveyed.

Table 2

Comparison of pre-test and post-test attitude means.

	Pre-Test	Post-Test
Attitude toward chemistry	86.2	91.0
Attitude toward laboratory work	84.3	88.8
Attitude toward honors classes	91.3	96.1
Attitude toward using the packets	87.2	99.2
Average for all areas	87.3	93.8

Discussion of the Result of the Achievement Test

The result of the achievement test for the three years of the program is summarized in Table 3. The honors chemistry class of 1976-77 using the packets achieved at a higher level on the 1974 ADV-Chemistry test, ACS-NSTA than the previous honors chemistry classes who used the same material but without the packets. No claim is made that the packets alone increased the achievement of the 1976-77 honors chemistry students.

Table 3

Comparison of achievement on ADV-Chem.-1974 ACS-NSTA chemistry test with and without the packets*

	Low Score	High Score	Mean Score	%ile Low Score	%ile High Score	Mean %ile
1974-75 Without Packets	1	46	30.4	4	87	50
1975-76 Without Packets	15	69	34.4	20	99	62
1976-77 Using Packets	24	69	42.5	32	99	80

**Norms were based on a mean of 3.3 semesters of chemistry, 2.0 semester of physics, and 8.0 semesters of mathematics.*

Summary

1. Students who worked independently using the packets achieved as well as the students in honors chemistry class on the packet tests.

2. The attitude tests show there was a positive change in attitude toward chemistry. There was a significant positive increase toward the use of the packets.

3. The chemistry class of 1976-77 using the packets achieved at a higher level on the 1974 ADV-Chemistry, ACS-NSTA test than the previous honors classes who used the same material but without the organization of the material into packet form.

4. No claim is made that the packets alone increased the achievement of the 1976-77 honors chemistry class. The positive image this class had towards themselves and toward chemistry was a major contributing factor. No doubt the Hawthorne effect contributed to the success of the packet program because the students were actively involved in the revision of the packets and the tests.

One set of the packets and tests are available at cost of reproduction of the materials. Write to Roger Spratt, Science Curriculum Coordinator, Ames Community School District, 120 South Kellogg, Ames, Iowa 50010, for details.

Current work on this program consists of revising the packets for the 4th edition of *Chemical Principles* (1977) and the revised 2nd edition of *Chemical Principles in the Laboratory* (1977). Don Murphy of Hoover High School in Des Moines, Iowa, is collaborating with this revision and will use the revised packets for his honors chemistry class during the 1977-78 school year.

Acknowledgments

Final development and publication of this material has been possible by a Teacher Incentive Award from the State of Iowa Department of Public Instruction.

We are also appreciative of the help received from Dr. Luther Kiser, Assistant Superintendent for Curriculum; Dr. Ralph Farrar, Principal, Ames Senior High School; and Mr. Roger Spratt, Science Curriculum Coordinator; who were very helpful in the packet production.

We are very grateful to the former Ames High School Honors students who aided in the development of the material and the revisions.

The following gave permission to reproduce laboratory data tables and questions:

Chemical Principles in the Laboratory, 2nd ed., Slowinski, Masterton, and Wolsey, published by W. B. Saunders Company, Philadelphia.

Freeman Library of Laboratory Separates in Chemistry, Vol. I, published by W. H. Freeman and Company, San Francisco.

Laboratory Experiments for Foundations of Chemistry, 2nd ed., 1973, Toon and Ellis, published by Holt, Rinehart, and Winston, New York.

Minigenerator Experiments in Nucleonics, edited by Kramer and Gemmill, Union Carbide Corporation, Tuxedo, New York.

The American Chemical Society has given permission to reproduce several articles and experiments from *Chemistry* and the *Journal of Chemical Education*.

We also have received permission to reproduce the student guide readings from the film loops used in the packets from: Ealing Film Loops, Cambridge, Mass,; Harper and Row Publishers, Hagerstown, Md.; and John Wiley and Sons, Inc., New York.

Citations and References

1. Jones, James Edward. *Computer-Simulated Experiments in High School Physics and Chemistry*. An unpublished doctoral thesis, Iowa State University, Ames, Iowa, 1972, p. 31.

2. Snider, J. C. and C. E. Osgood, editors. *Semantic Differential Techniques: A Sourcebook*. Aldine, Chicago, 1969, pp. 56-82. (This is an excellent source on semantic-differential scales.)

3. *Op. cit.*, p. 61.

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Dates to Remember in 1978

April 6-11 NSTA National Conference, Washington, D.C.

April 22-24 Iowa Academy of Science, University of Northern Iowa.

Nov. 2- 4 NSTA Regional Conference. Milwaukee, Wisconsin. A bus pool is being formed. Contact Ross Iverson, Marshalltown Public Schools, Marshalltown, Iowa.

Nov. 10 Iowa Science Teachers Fall Conference, Marshalltown.

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London International Youth Fortnight

Applications are invited from science students throughout the world to participate in the 1978 International Youth Science Fortnight, which will take place in London from July 26 through August 9.

The Fortnight is an annual gathering of about 300 students, aged 16 to 22, from Britain and other parts of the world. The participants stay in student hostels, follow a program of scientific lectures, visits and discussions, as well as social events. The cost is $270 plus transportation.

For further information write to the Council of International Contact, P.O. Box 818, 179-183 Fulham Palace Road, London, W6 8QU, England.

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Something Fishy

There are 40 million fishing licenses sold annually in the United States and only 2 million marriage licenses. Which proves one thing. People would rather fish than fight.